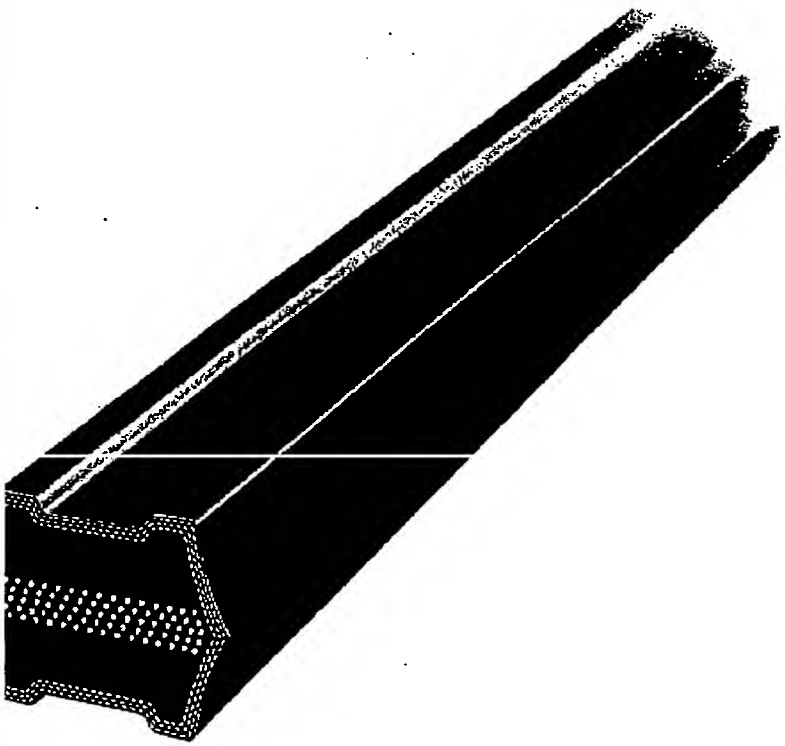

:IGURE 7 Double V-belt for use on serpentine drives.

:. Other Types of Power Transmission Belts

. V-Ribbed Belt

\nother type of belt was introduced in the 1950s which is a cross be-ween a flat belt and a V-belt. This belt is generally called a V-ribbed belt and was introduced under the trade name Poly-V.

This belt is essentially a flat belt with V-shaped ribs projecting from the bottom of the belt which guide the belt and make it more stable than a flat belt (see Figure 9). In the original concept, the V-ribs of the belt completely filled the grooves of the pulley. For this reason, the V-ribbed belt did not have the wedging action of the V-belt and consequently had to operate at higher belt tensions.

Later versions of V-ribbed belts have truncated ribs to more closely emulate the wedging effect of a V-belt. It is still common

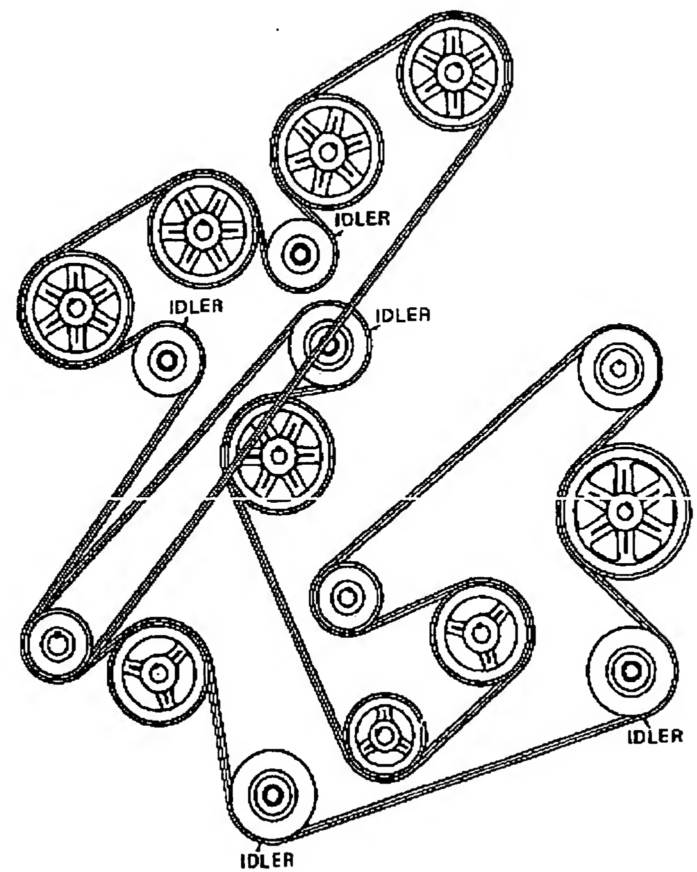

FIGURE 8 Serpentine-type drive using a double V-belt.

practice, however, to use higher tensions with V-ribbed belts than with V-belts because the V-ribbed belt still seats against the rounded land between pulley grooves.

While the V-ribbed belt is not as flexible as a flat belt, the smaller V-ribs still allow for a very flexible belt that performs well on small-diameter pulleys. On certain drives where the shafts and bearings will withstand higher operating tensions, the V-ribbed belt will give good performance on small pulley diameters.

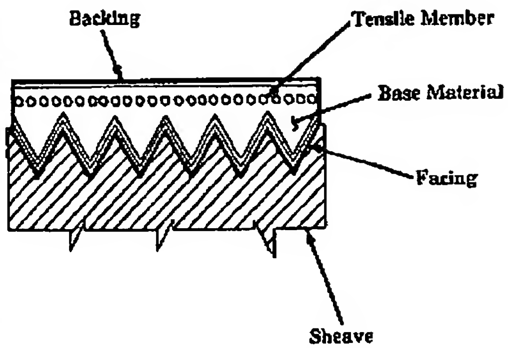

FIGURE 9 A V-ribbed belt with continuous tensile section like a flat belt.

A good example is the domestic clothes dryer. A speed ratio of over 30:1 is required between the motor and the drum. The V-ribbed belt will operate on a small enough motor pulley to achieve this high speed ratio while operating directly on the dryer drum like a flat belt (see Figure 10).

2. Synchronous Belt

A frictional drive like those using V-belts, V-ribbed belts or flat belts does not give exact driven speeds. There is a certain amount of belt "creep" (usually about 0.5% for a V-belt) which makes it impossible to drive machinery such as the indexing heads of machine tools or the camshaft of an internal combustion engine where synchronization is needed. This was a segment of the power transmission market not open to belts until about 1950 when the synchronous belt was developed.

Synchronous belts are capable of transmitting power through the positive engagement of teeth on the belt with corresponding teeth on the pulley. This creates the synchronization between the driver and the driven shafts which is essential on some types of applications. See Figure 11 for a basic description of a synchronous belt mating with the pulley.

Synchronous belt drives have a distinct advantage over gears or chain drives because they can transmit reasonably high loads at a wide variety of speeds with a low noise level and without lubrication. The shock-absorbing characteristics of the low modulus rubber teeth

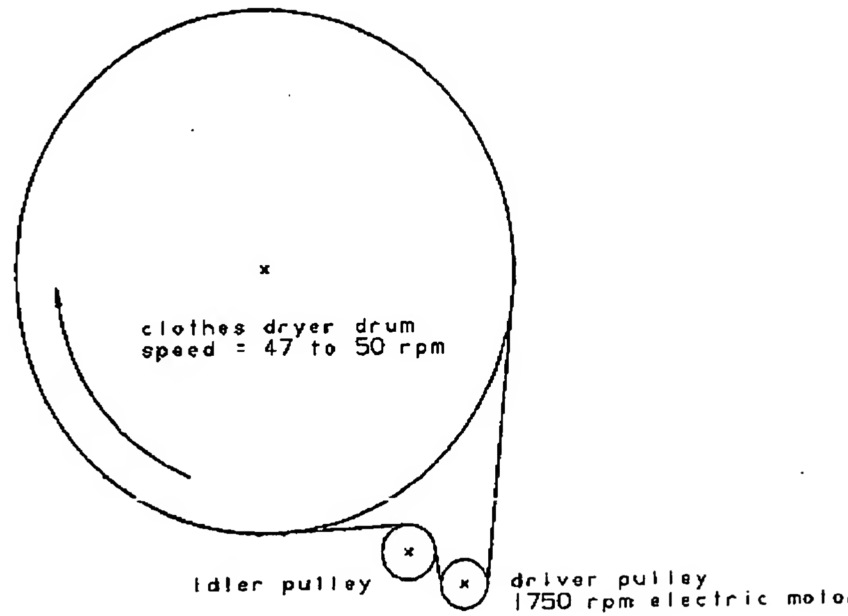

FIGURE 10 A V-ribbed belt driving the drum of a domestic clothes dryer.

against the metal pulley teeth are also an advantage on certain applications.

Synchronous belts can also be used for normal power transmission drives where synchronous speeds are not required. However, on these types of applications, the more popular V-belt generally proves to be a less expensive and more reliable drive.

~~IV. NOMENCLATURE FOR POWER TRANSMISSION BELTS AND PULLEYS~~

~~A general discussion on belt and pulley nomenclature is given in this chapter. More specific detail will be given in the engineering chapters for each specific belt type.~~

I. INTRODUCTION

A. Definition

Synchronous-belt drives operate on the "tooth grip" principle. The belt may be described as resembling a flat belt with evenly spaced teeth on the inside surface. The precisely molded teeth of the belt are designed to make positive engagement with suitably shaped mating grooves on the pulley or sprocket.

Synchronous belts do not rely on friction to transmit power. As such, they should not be confused with molded-notch V-belts which transmit power by the wedging action of the V-shape. Because of the positive tooth engagement, there is little relative motion between the belt and pulley; subsequently there is no slip.

This no slip characteristic provides exact synchronization between a prime power source and a driveN unit. Thus, synchronous-belt drives are extremely useful where indexing, positioning, or a constant speed ratio is required as a machine function.

B. Terminology

Figures 1 and 2 define the belt pitch, pitch diameter, outside diameter, and pitch line differential for the conventional timing belt and newer curvilinear profiles.

It is important to note timing belt pulleys are designated as "pulleys" because of the groove design which causes the belt to actually pull on the outside of the pulley. The name pulley is carried over from flat-belt technology which is the ancestor of the timing belt. The newer curvilinear designation uses the name sprockets since they are designed to replace chain drives in some applications.

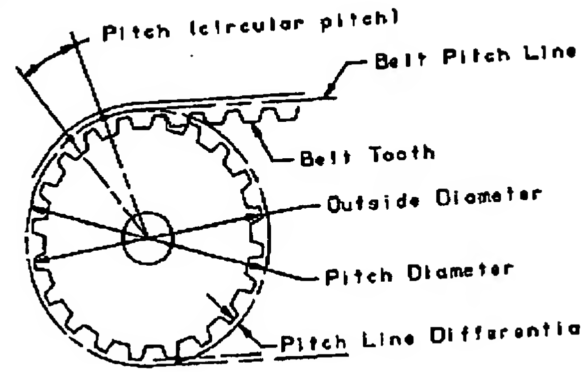

FIGURE 1 Timing belt and pulley nomenclature.

C. Applications

Synchronous belts are recommended primarily where synchronization of the driveR shaft to the driveN shaft is required. Because of the positive drive nature similar to chain or gear drives, synchronous-belt drives give 100% transfer of rotational speeds.

Synchronous belt drives are as much as 98% efficient. This high efficiency is, of course, primarily due to the positive, no-slip characteristic of synchronous belts. Reduced binding tensions also help

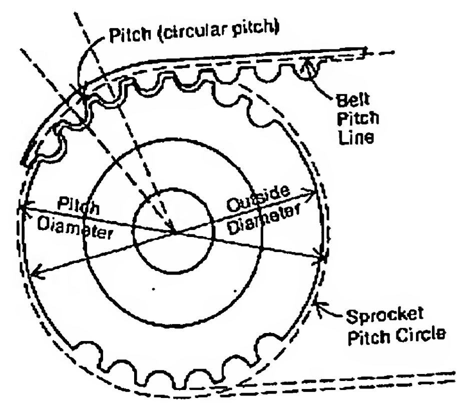

FIGURE 2 Curvilinear profile belt and sprocket nomenclature.

to increase efficiencies. Since the belt is similar to a flat belt, it operates at low flat-belt temperatures. Also, the low profile and mass reduce centrifugal tension which further increases belt efficiency.

Because of the high resistance to elongation, synchronous belts can be used where access for maintenance is limited. However, some adjustment must be provided when installing a synchronous-belt drive, as with nearly all power transmission methods, due to belt, pulley, and assembly tolerances.

II. BASIC TYPES OF INDUSTRIAL SYNCHRONOUS BELTS

A. Timing Belt

The initial development of the synchronous belt was started around 1940 by the L. H. Gilmer Company. Gilmer saw a need for a power transmission system to fill the void between roller-chain and conventional rubber V-belts. Development was interrupted by World War II, but was completed later in that same decade. The first synchronous belt product line included one trapezoidal tooth profile and pitch.

Today, a full line of various sizes of timing belts is available. They range from the mini-extra-light (MXL) pitch for subfractional HP drives up to double-extra-heavy (XXH) pitch with load capacities of over 100 HP. Figure 3 shows the six cross-sections which are in common industry use. Table 1 lists the standard belt lengths and widths which are available.

1. Belt Designation

Timing-belt sizes are indicated by a standard number. The size designation is described in the standard IP-24 published by The Rubber Manufacturers Association (RMA), Mechanical Power Transmission Association (MPTA), and The Rubber Association of Canada (RAC).

The first digits specify the belt pitch length to 0.1 in. increments. Following the belt-pitch length designation is a letter (or letters) indicating the pitch or belt section. The belt width is indicated in hundredths of an inch by the number following the section. For example, a timing belt that has a pitch length of 85 in., 0.500-in. pitch, 1 1/2-in. wide, would be designated as 850H150.

The tooth dimensions for double-sided belts are identical to those of single-sided belts. A double-sided belt that is the same size as shown in the above example would be indicated as 850DH150 per the IP-24 standard. However, most manufacturers have adopted their own designation to describe double-sided timing belts. An example is TP850H150 (TP = Twin Power[R]).

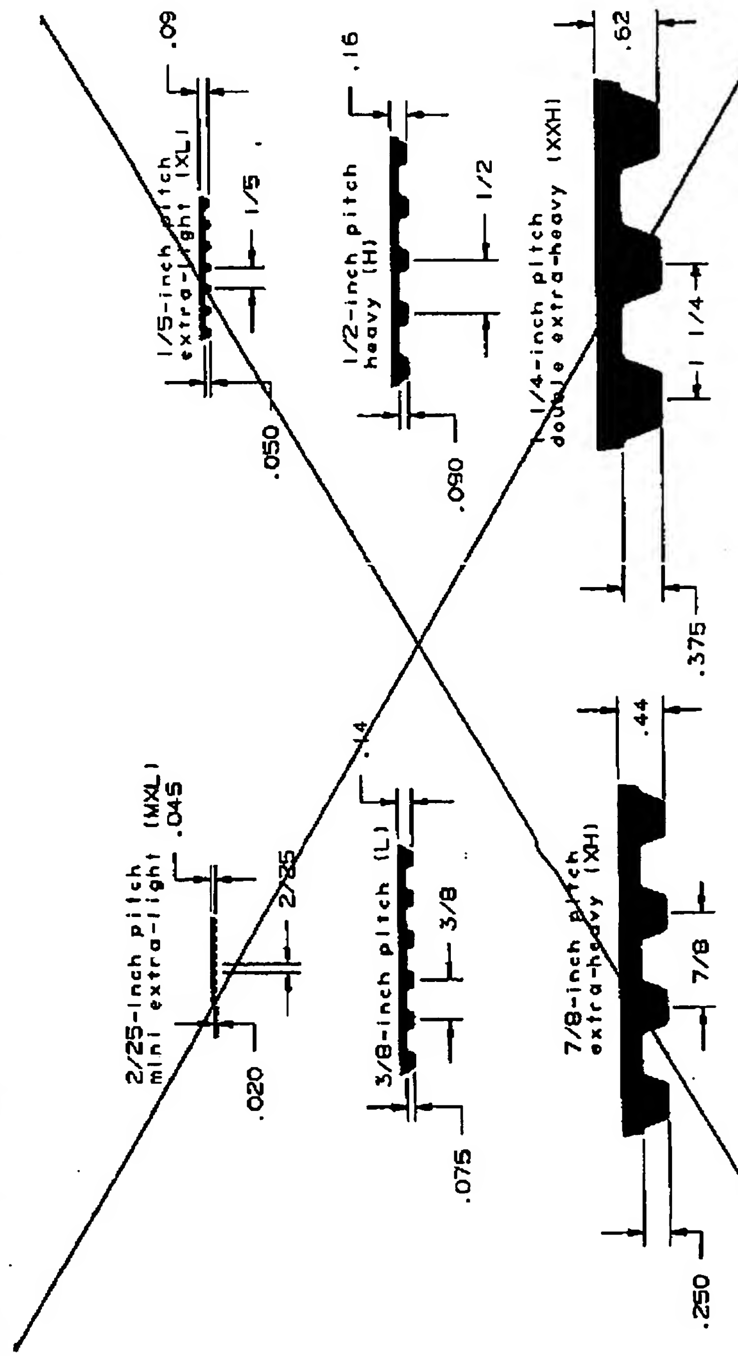

FIGURE 3 Timing belt cross section.